Small Business Innovation Research/Small Business Tech Transfer

Efficient, High Power Density Hydrocarbon-Fueled Solid Oxide Stack System, Phase II

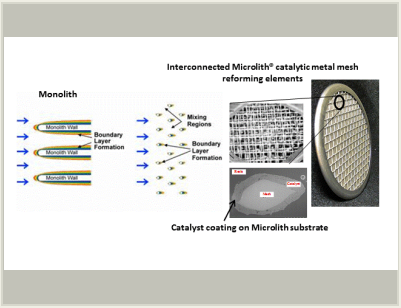
Completed Technology Project (2016 - 2021)

Project Introduction

Precision Combustion, Inc. (PCI) proposes to develop and demonstrate an innovative high power density design for direct internal reforming of regolith off-gases (e.g., methane and high hydrocarbons) within a solid oxide stack. The resulting breakthrough design offers the potential for higher overall efficiency, simplifies the system, and enables further compactness and weight reduction of the fuel cell system while significantly improving SOFC stack efficiency and the conditions for long system life. The approach also offers the potential to operate with a wide range of input fuels (i.e., high hydrocarbons as well as various levels of CO2 and water) without forming carbon. In Phase I all objectives and proposed tasks were successfully completed to demonstrate internal reforming concept for a high-power density, CH4-fueled solid oxide stack system. In Phase II, we will build on Phase I success to develop, fabricate, and demonstrate a TRL-4, breadboard solid oxide stack system operating with CH4. PCI's integrated reformer/fuel cell system will be much smaller, lighter, more thermally effective and efficient, and less expensive than current technology or prospective alternative structured catalytic reactor technologies. This effort would be valuable to NASA as it would significantly reduce the known spacecraft technical risks and increase mission capability/durability/efficiency while at the same time increasing the TRL of the solid oxide systems for ISRU application.

Anticipated Benefits

NASA's requirement for the solid oxide fuel cell and electrolyzer module is a long term one, and will be mission critical for space exploration, NASA ISRU missions, and extending human presence across the solar system with its Morpheus Project. PCI's integrated reformer/fuel cell system will be much smaller, lighter, more thermally effective and efficient, durable, and will offer advantages in terms of reduced launch mass/cost and reduced requirement for supplemental material re-supply.Targeted non-NASA applications include solid oxide fuel cell based application in the aerospace and distributed power generation industry. The implementation of PCI's internal reformer technology will lead to significant cost reduction by eliminating external reformer and heat exchanger in the SOFC system, plus a considerable gain in stack efficiency will significantly make the life cycle cost of owning SOFC system more economically favorable and competitive with respect to other distributed power generation systems (both conventional and renewable).



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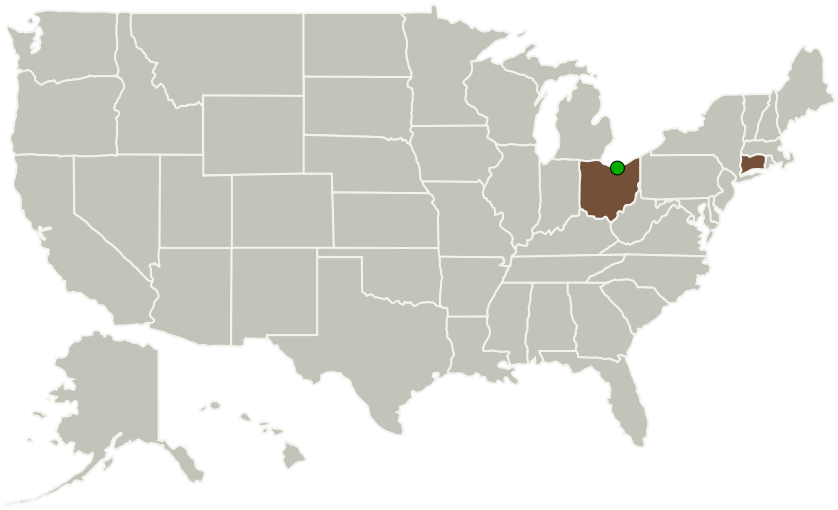
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Precision Combustion, Inc.	Lead Organization	Industry	North Haven, Connecticut
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations	
Connecticut	Ohio

Project Transitions

May 2016: Project Start

February 2021: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/139851)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Precision Combustion, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Project Managers:

Matthew C Deans
Ian J Jakupca

Principal Investigator:

Christian Junaedi

Co-Investigator:

Christian Junaedi

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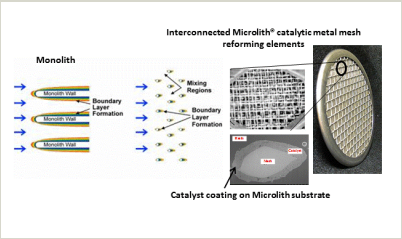
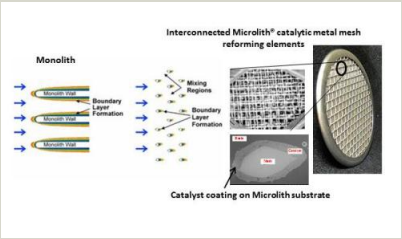
Images



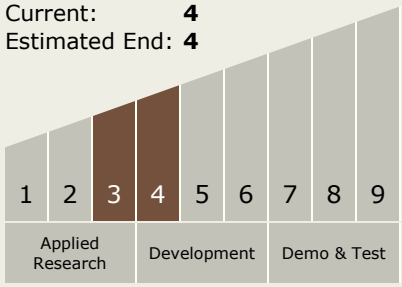
Briefing Chart Image
Efficient, High Power Density Hydrocarbon-Fueled Solid Oxide Stack System, Phase II *(https://techport.nasa.gov/image/133735)*



Final Summary Chart Image
Efficient, High Power Density Hydrocarbon-Fueled Solid Oxide Stack System, Phase II *(https://techport.nasa.gov/image/130117)*

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System